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and forest management, sawing and planting, felling and measurement, there are chapters on forest animals, birds, insects, weeds, and fungi. The final chapter deals with the uses of British timber. The book is in an easily readable style and seems to give a good idea of forestry as practiced in Great Britain.—GEO. D. FULLER.

NOTES FOR STUDENTS

Vegetation and climate.—The most recent phase of ecology, which finds expression in attempts to introduce quantitative methods for the investigation of vegetation and of the factors that determine its nature and distribution, has received a notable contribution in a recent volume by LIVINGSTON and SHREVE.⁹ "The existence, limits, and movements of plant communities are controlled by physical conditions" is stated as a fundamental law of plant geography, and an attempt is made to map the distribution both of various physical factors and of a considerable number of plants and plant communities. Data for the latter are obtained from a variety of sources, and more particularly from SHREVE's well known map of the vegetation areas of the United States. In fact a generalized form of this map is employed as a basis upon which to display the distribution of climatic factors. In addition to this, ranges of various plant species and groups of species, such as deciduous, microphyllous, and broad-leaved evergreen trees, are delimited. Here emphasis is placed upon the lack of anything like an adequate knowledge of the ecological distribution, based on relative abundance, dominance, or density of stand, of any considerable number of plants even in such a well explored land as our own.

A general discussion of the influence of the environment on plant life classifies environmental factors which are important in distribution as: (1) moisture conditions, (2) temperature conditions, (3) light conditions, (4) chemical conditions, (5) mechanical conditions. These are considered in turn. In discussing the supply of water to vegetation the "residual soil moisture content" of the soil is not regarded as a soil constant, in spite of many data tending to prove that within very considerable limits its constancy holds. No mention is made of wilting or hygroscopic coefficients, nor of the notable contributions of such well known investigators as ALWAY, SHULL, KEEN, and BOUYOUCOS. These omissions constitute the most serious defect in an otherwise admirable and comprehensive volume.

The tabulation of the climatological data, used for the construction of the maps, in a form that makes them available for future investigators is highly to be commended. As an example of such accumulations of exact information regarding conditions limiting growth and distribution, the table of frost data may be cited. Here for 1803 different stations the altitude, number of years of record, average date of the last frost in spring, and the earliest in the

⁹ LIVINGSTON, B. E., and SHREVE, F., The distribution of vegetation in the United States as related to climatic conditions. Carn. Inst. Wash. Publ. 284; pp. xvi+590. pls. 73. figs. 74. 1921.

fall, together with the length of the average frostless season, are given in readily accessible form, the resulting tables covering thirty-three pages. These data are plotted as isoclimatic lines on the map of the United States. Among the factors thus tabulated and mapped are: temperature efficiencies for the frostless season expressed as (1) remainder indices, (2) exponential indices, and (3) physiological indices; absolute temperature maxima and minima; average daily temperature for the coldest and hottest weeks of the year; mean daily precipitation for the frostless season together with the number of rainy and dry days for same; normal annual precipitation; atmospheric evaporating power; ratios of precipitation to evaporation; aqueous vapor pressure; relative air humidity; wind velocity; sunlight; and moisture temperature indices.

It is recognized that there are decided difficulties in establishing correlations of these isoclimatic areas with the distribution of plant species, growth forms, and vegetational areas, but even here the efforts of the authors have met with considerable success. The statement of climatic extremes for various vegetational features, in 128 tables covering 86 pages, certainly gives more exact information than was ever before available regarding the conditions under which various plant communities and plant species have developed. A very decided addition to our knowledge of the exact conditions that probably determine general vegetational areas is also provided in the plotting of the comparative ranges and intensities of twelve leading climatic conditions for nine such areas, for the life-zones of Merriam, and for over thirty plant species.

The book shows the uniformly good printing of text and maps characteristic of the publications of the Carnegie Institution of Washington, and seems reasonably free from errors of typography and in the use of specific names. It will be indispensable to all ecologists who wish to take account of climatic factors, and will become increasingly useful as increasing knowledge permits more accurate interpretation of such factors and their closer correlations with the resulting displays of plant life.—GEO. D. FULLER.

Anatomy and biology of gymnosperm leaves.—While there have been several investigations of leaves in various groups of gymnosperms, there has been no comprehensive study of the entire line. Consequently, a recent work by FEUSTEL¹⁰ will be welcomed by those who wish to find, in compact form, a survey of the literature of the subject. The author states frankly that his work is only a summary of the literature, not an investigation; but his observations, especially along biological lines, and the comparative presentation of anatomical features are suggestive. The various orders are treated separately.

CYCADOFILICALES.—The term *Pteridospermae* is used for this order. The mode of treatment is similar in the other orders. In general appearance the leaves are fernlike, but the internal structure shows a mixture of fern and

¹⁰ FEUSTEL, HERM., *Anatomie und biologie der Gymnospermenblätter*. Beih. Bot. Centralbl. 38:177-257. 1921.